Paper AOP100-212

Functionalizing glass by inducing local compositional changes with ultrafast lasers

Authors: J. Solis, Consejo Superior de Investigaciones Cientificas (Spain)

The properties of a glass can be potentially tuned through small modifications of the composition and/or the structural arrangements of both modifiers and glass forming elements. Indeed, local modifications of the composition of glass upon irradiation with ultrashort laser pulses have been observed many times since Hirao and co-workers reported local changes in the composition of glasses irradiated to induce the precipitation of non-linear crystals in glass matrices. Since then, fs-laser induced element redistribution (FLIER) processes have been investigated by several research groups with the aim of modifying in a controlled manner the local composition of glasses to promote different functionalities.

Likely, the most successful application of FLIER for glass functionalizing up to date has been the production by our research group of high refractive index contrast, low loss optical waveguides, and very efficient waveguide optical amplifiers, and lasers in phosphate glass. In this case, a heavier glass modifier element, acting as a refractive index carrier (e.g. La^{3+}) migrates in the opposite direction to a fast diffusing alkaline modifier (e.g. K^{+}) during the laser-writing process, forming the positive index region contrast where light guiding occurs. We have used this principle to successfully produce glass samples with a composition specifically pre-designed for generating efficient optical waveguides by fs-laser writing.

The presentation will provide an overview of fs-laser induced ion migration phenomena in glasses, with emphasis on recent results of our research group regarding its use for the production of photonic devices and other prospective applications.

Paper AOP100-213

Attosecond soft X-ray spectroscopy in condensed phase

Authors: J. Biegert, ICFO - Institut de Ciències Fotòniques (Spain) and ICREA (Spain)

Phase transitions of solids and structural transformations of molecules are canonical examples of important photo-induced processes, whose underlying mechanisms largely elude our comprehension due to our inability to correlate electronic excitation with atomic position in real time. Here, we present a decisive step towards such new methodology based on water-window- covering (284 eV to 543 eV) attosecond soft X-ray pulses that can simultaneously access electronic and lattice parameters via dispersive X-Ray absorption fine-structure (XAFS) spectroscopy. We validate attoXAFS with an identification of the σ^* and π^* orbital contributions to the density of states in graphite. Moreover, we will show that this method can provide a real-time view on the light- field-driven carrier dynamics. This work demonstrates the concept of attoXAFS as a powerful real-time investigative tool which is equally applicable to gas-, liquid- and condensed phase.

Paper AOP100-214

Multifunctional low cost metal oxides: from materials to devices

Authors: E. M. Fortunato, Univ Nova de Lisboa (Portugal)

After the huge success and revolution of transparent electronics and with the worldwide interest in displays where metal oxide thin films (MOTF) have proved to be truly semiconductors, display backplanes have already gone commercial due to the huge investment of several high profile companies: SHARP, SAMSUNG, LG, BOE. Recently IDTechEx estimated that8 km sqr of MOTF backplanes will be used in the OLED and LCD industry by 2024, enabling a 16 billion USD market at the display module level alone.

Currently, semiconductor technology combines two very different and often incompatible materials leading to sub-optimal properties, namely simple semiconductors and oxides. The former (Si, Ge) are essential for efficient carrier transport, while the latter enable various functionalities. The challenge of the proposed work is to develop MOTF and TFTs with properties comparable to those of the simple semiconductors. In addition, the properties of many MO have never been explored. It is notable that MO provide a unique possibility to tune optical and electronic properties, from insulation to metallic conduction; besides that MO are chemically stable, mostly non-toxic and abundant materials, often manufactured by low cost methods, under ambient conditions. Consequently, devices made of MO are inexpensive, very stable and environmentally safe, the 3 most important requirements for electronics.

In this talk we will present results on recent new technologies developed at CENIMAT|i3N like transparent electronics and paper electronics where it is possible to have the use of sustainable materials used in disruptive applications.